Claims

[c1] 1.A hydrogen fueled reciprocating spark ignition engine, comprising:
a fuel system for providing gaseous hydrogen to the cylinders of the engine;
a lean NOx trap coupled to the engine for treating the engine's exhaust;
an EGR system for providing recirculated exhaust gas to the engine; and
a controller for operating the fuel system and the EGR system during periodic purging of the lean NOx trap such that the engine is operated at a richer-than-stoichiometric air/fuel ratio, and with the mass of EGR approximating 40-80% of the mass of air and fuel.

[c2] 2.A hydrogen fueled reciprocating spark ignition engine according to Claim 1, wherein the fuel system and the EGR system are operated by the controller to purge the lean NOx trap on a timed basis.

[c3] 3.A hydrogen fueled reciprocating spark ignition engine according to Claim 1, wherein the fuel system and the EGR system are operated by the controller to purge the lean NOx trap when a model run by the controller indicates that the lean NOx trap should be purged.

[c4] 4.A hydrogen fueled reciprocating spark ignition engine according to Claim 2, wherein the fuel system and the EGR system are operated to purge the lean NOx trap for about 3-5% of the engine's operating time.

[c5] 5.A hydrogen fueled reciprocating spark ignition engine according to Claim 1, wherein the compression ratio of the engine is greater than 10:1.

[c6] 6.A hydrogen fueled reciprocating spark ignition engine according to Claim 1, wherein the compression ratio of the engine is within the range of approximately 14:1-15:1.

[c7] 7.A hydrogen fueled reciprocating spark ignition engine according to Claim 1, wherein the fuel system and the EGR system are controlled during operation at or near maximum load so as to achieve an air/fuel ratio and EGR rate which are comparable to the air/fuel and EGR rate utilized during purging of the lean NOx trap.

[c8] 8.A hydrogen fueled reciprocating spark ignition engine according to Claim 1, further comprising a three way catalyst mounted upstream of the lean NOx trap.

[c9] 9.A hydrogen fueled reciprocating spark ignition engine according to Claim 1, further comprising an NOx sensor mounted downstream from the lean NOx trap, with said sensor generating a signal corresponding to the concentration of NOx in the exhaust stream, and with said sensor being operatively connected with said controller.

[c10] 10.A hydrogen fueled reciprocating spark ignition engine according to Claim 1, further comprising an SCR converter mounted downstream from the lean NOx catalyst.

[c11] 11.A hydrogen fueled reciprocating spark ignition engine according to Claim 1, further comprising an auxiliary fuel system for providing hydrogen to the engine's exhaust system upstream of the lean NOx trap.

[c12] 12.A hydrogen fueled reciprocating spark ignition engine according to Claim 1, wherein the engine is operated at an equivalence ratio of about 0.15 to 0.65, except when the lean NOx trap is being purged.

[c13] 13.A hydrogen fueled reciprocating spark ignition engine according to Claim 1, wherein the engine is operated at an equivalence ratio of about 0.15 to 0.65, excepting when the lean NOx trap is being purged and when the engine is being operated at or near maximum load.

[c14] 14.A hydrogen fueled reciprocating spark ignition engine according to Claim 1, further comprising a three-way catalyst mounted downstream from the lean NOx catalyst.

[c15] 15.A hydrogen fueled reciprocating spark ignition engine according to Claim 1, wherein the mass flow of EGR is approximately equal to the mass of air and

[c16] 16.A method for operating a reciprocating internal combustion engine equipped with a lean NOx trap on gaseous hydrogen, comprising the steps of:
operating the engine at an equivalence ratio of about 0.15 to 0.65, except when purging the lean NOx trap; and

operating at an equivalence ratio of about 1.1 when purging the lean NOx trap.

[c17] 17.A method according to Claim 16, further comprising the step of operating the engine with the mass of EGR being approximately equal to the mass of air and fuel when the lean NOx trap is being purged.

[c18] 18.A method according to Claim 16, further comprising the step of operating the engine with the mass of EGR being approximately equal to the mass of air and fuel when the lean NOx trap is being purged and when the engine is operating at or near maximum load.

[c19] 19.A method for operating a reciprocating internal combustion engine, comprising the steps of:
providing substantially premixed air and hydrogen to a combustion chamber of the engine wherein said air and hydrogen are at an equivalence ratio of approximately unity; and
providing residual gases to the combustion chamber, with the mass of the residual gases exceeding 40% of the total mass of gases provide to the combustion chamber.

[c20] 20.A method according to Claim 19, wherein the residual gases comprise engine exhaust gas trapped in the combustion chamber from a prior combustion event and engine exhaust gas recirculated to the combustion chamber.

[c21] 21.A method according to Claim 19, wherein the engine has a three-way catalyst disposed in an exhaust system connected to the engine.